MBA PULS 300

4 … 20 mA/HART two-wire

Document ID:
36824

Contents

1 About this document

1.1 Function 4
1.2 Target group 4
1.3 Symbolism used 4

2 For your safety

2.1 Authorised personnel 5
2.2 Appropriate use 5
2.3 Warning about misuse 5
2.4 General safety instructions 5
2.5 CE conformity 6
2.6 Fulfillment of NAMUR recommendations 6
2.7 Radio approval for Europe 6
2.8 Radio approval for USA/Canada 6

3 Product description

3.1 Configuration 7
3.2 Principle of operation 7
3.3 Packaging, transport and storage 8
3.4 Accessories and replacement parts 8

4 Mounting

4.1 General instructions 9
4.2 Collar or adapter flange 9
4.3 Mounting strap 10
4.4 Mounting instructions 12

5 Connecting to power supply

5.1 Preparing the connection 23
5.2 Connection 24
5.3 Wiring plan, single chamber housing 25
5.4 Wiring plan, double chamber housing 25
5.5 Wiring plan with double chamber housing Ex d 27
5.6 Switch on phase 27

6 Set up with the indicating and adjustment module

6.1 Insert indicating and adjustment module 29
6.2 Adjustment system 30
6.3 Parameter adjustment 31
6.4 Saving the parameter adjustment data 38

7 Diagnosis, fault rectification and service

7.1 Maintenance 40
7.2 Error messages according to NE 107 40
7.3 Rectify malfunctions 42
7.4 How to proceed in case of repair 42

36824-EN-100208

8 Dismounting

8.1 Dismounting steps 43
8.2 Dispose 43

9 Supplement

9.1 Technical data 44
9.2 Dimensions 51

Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained qualified personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.
Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.
Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

- **List**
  The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence**
Numbers set in front indicate successive steps in a procedure.

2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use

MBA PULS 300 is a sensor for continuous level measurement.

You can find detailed information on the application range in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

This is a state-of-the-art instrument that fulfils the prevailing regulations and guidelines. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the required occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

The safety approval markings and safety tips on the device must be also observed.

Depending on the instrument version, the emitting frequencies are in the C or K band range. The low emitting frequencies are far below the internationally approved limit values. When used correctly, no health impairment is expected.

2.5 CE conformity

The device fulfills the legal requirements of the applicable EC guidelines. By attaching the CE mark, we provide confirmation of successful testing.

2.6 Fulfillment of NAMUR recommendations

The device fulfills the requirements of the applicable NAMUR recommendations.

2.7 Radio approval for Europe

The instrument is approved according to EN 302372-2:2006-08 for use in closed vessels.

2.8 Radio approval for USA/Canada

The radar sensor MBA PULS 300 with all antenna versions is FCC/IC approved.

Modifications not expressly approved by the manufacturer will lead to expiry of the operating licence according to FCC/IC.

The instrument is in conformity with part 15 of the FCC directives and fulfills the RSS-210 regulations. Note the corresponding regulations for operation:

- The instrument must not cause any interfering emissions
- The device must be insensitive to interfering immissions, including those that may cause undesirable operating conditions.

The instrument is designed for operation with an antenna according to chapter "*Dimensions*" of this operating instructions manual, with a max. amplification of 33 dB. The instrument must not be operated with antennas not listed therein or those having an amplification of more than 33 dB. The required antenna impedance is 50 Ω.

3 Product description

3.1 Configuration

Type label

The type label contains the most important data for identification and use of the instrument:

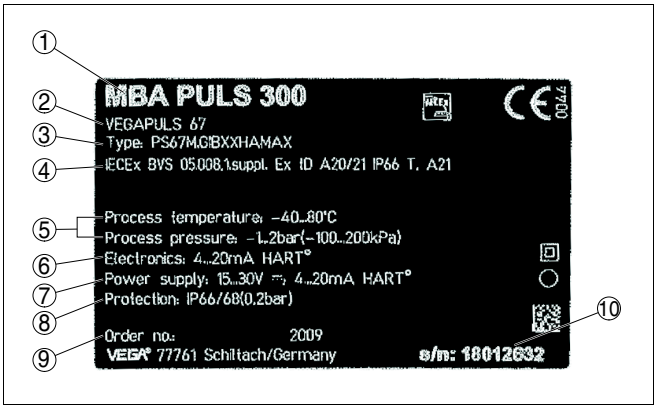


Fig. 1: Structure of the type label (example)

1 *Instrument type*
2 *Product code*
3 *Approvals*
4 *Process temperature, process pressure*
5 *Electronics*
6 *Protection rating*
7 *Order number*
8 *Serial number of the instrument*

Scope of delivery

The scope of delivery encompasses:

- Radar sensor
- Documentation
  - this operating instructions manual
  - Operating instructions manual "*Indicating and adjustment module*" (optional)
  - Supplementary instructions manual "*Heating for indicating and adjustment module*" (optional)
  - Supplementary instructions manual "*Plug connector for continuously measuring sensors*" (optional)
  - Ex-specific "*Safety instructions*" (with Ex-versions)
  - if necessary, further certificates

3.2 Principle of operation

Application area

The MBA PULS 300 is particularly suitable for measurement of bulk solids in silos with up to 15 m height.

Functional principle

The antenna of the radar sensor emits short radar pulses with a duration of approx. 1 ns. These pulses are reflected by the product and received by the antenna as echoes. The running time of the radar pulses from emission to reception is proportional to the distance and hence to the level. The determined level is converted into an appropriate output signal and outputted as measured value.

3.3 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test according to DIN EN 24180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out under consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be reported.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 … 85 %

3.4 Accessories and replacement parts

Indicating and adjustment module

The indicating and adjustment module is used for measured value indication, adjustment and diagnosis. It can be inserted into the sensor and removed at any time.

You find further information in the operating instructions "*Indicating and adjustment module*" (Document-ID 36825).

4 Mounting

4.1 General instructions

Moisture

Use the recommended cables (see chapter "*Connecting to power supply*") and tighten the cable gland.

You can give your instrument additional protection against moisture penetration by leading the connection cable downward in front of the cable entry. Rain and condensation water can thus drain off. This applies mainly to outdoor mounting as well as installation in areas where high humidity is expected (e.g. through cleaning processes) or on cooled or heated vessels.

Suitability for the process conditions

Make sure that all parts of the instrument exposed to the process, in particular the antenna, seal and process fitting, are suitable for the existing process conditions. These include above all the process pressure, process temperature as well as the chemical properties of the medium.

You can find the specifications in chapter "*Technical data*" or on the type label.

4.2 Collar or adapter flange

A corresponding collar flange for DN 80 (ASME 3" or JIS 80) as well as a suitable adapter flange are available for mounting MBA PULS 300.

With the housing versions plastic, aluminium single chamber and stainless steel, the collar flange can be placed directly over the housing. With the aluminium double chamber housing, retroactive mounting in this way is not possible - the mounting type must be specified with the order.

You can find drawings of these mounting options in chapter "*Dimensions*".

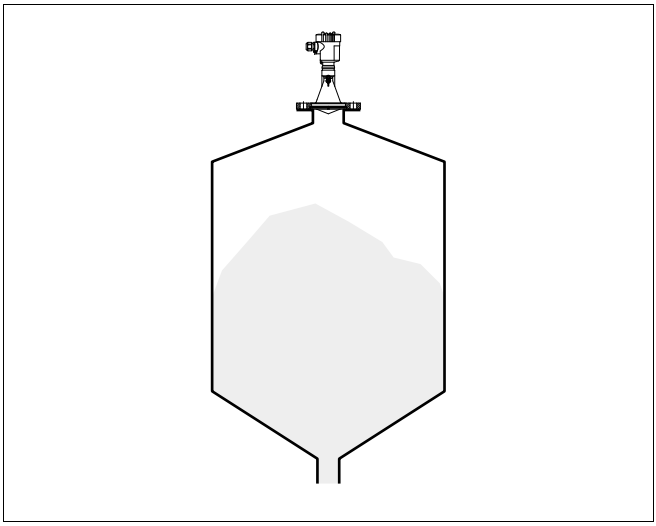


Fig. 2: Flange mounting of the radar sensor

4.3 Mounting strap

Mounting strap

The mounting strap enables easy mounting on the vessel wall or silo top. It is suitable for wall, ceiling or boom mounting. Especially in open vessels, this is a very easy and effective way to align the sensor to the bulk solid surface.

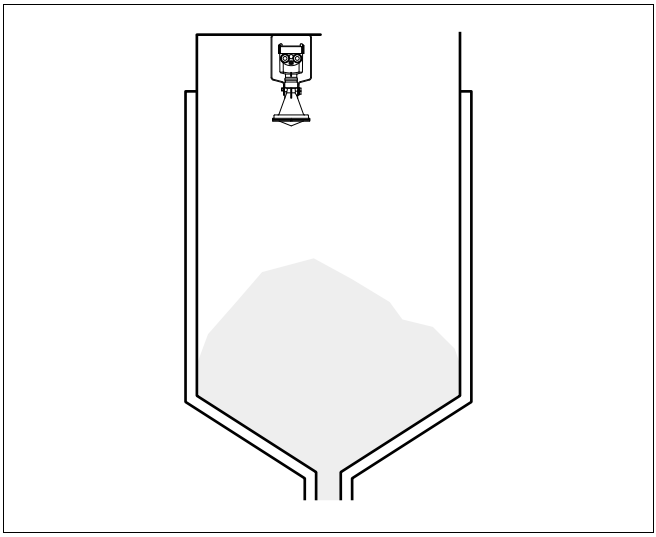


Fig. 3: Radar sensor with mounting strap

The strap is supplied unassembled and must be screwed to the sensor before setup with three hexagon nuts M5x10 and spring washers. Max. torque, see chapter "*Technical data*". Required tools: Allen wrench size 4.

There are two ways to screw the strap onto the sensor. Depending on the selected version, the sensors can be swivelled in the strap as follows:

- Single chamber housing
  - Angle of inclination 180°, infinitely variable
  - Angle of inclination in three steps 0°, 90° and 180°
- Double chamber housing
  - Angle of inclination 90°, infinitely variable
  - Angle of inclination in two steps 0° and 90°

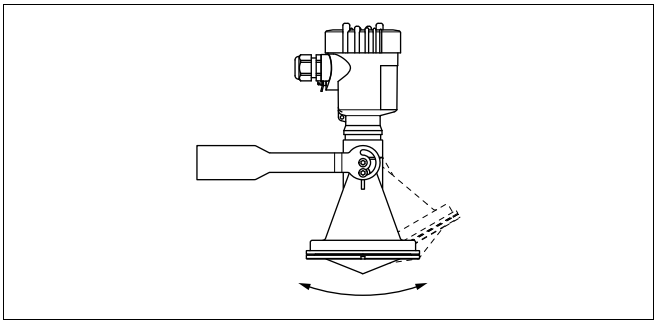


Fig. 4: Adjustment of the angle of inclination

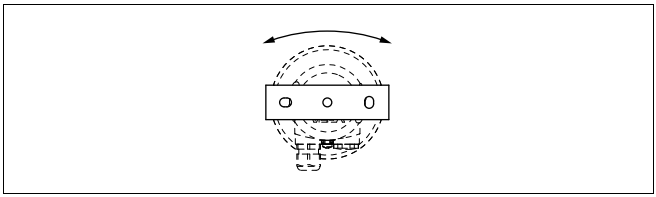


Fig. 5: Turning by fastening in the centre

4.4 Mounting instructions

Polarisation plane

The emitted radar pulses of MBA PULS 300 are electromagnetic waves. They thus have electrical and magnetical components that are perpendicular to each other. The polariation plane is defined by the direction of the electrical component. With radar sensors, the polarisation can be used to considerably reduce the effect of false

echoes by turning the instrument in the connection flange or mounting boss. The position of the polarisation plane is marked on the instrument.

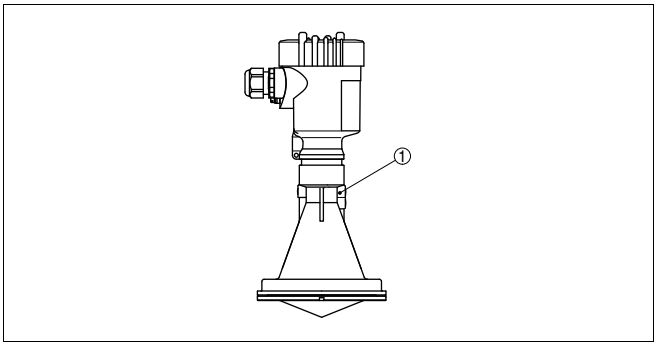


Fig. 6: Position of the polarisation plane of MBA PULS 300

1 Marking bars

Mounting position

Mount the instrument at least 200 mm (7.874 in) away from the vessel wall.

If you cannot keep this distance you should carry out a false echo storage before setup. This applies mainly if buildup on the vessel wall is expected. In this case, we recommend repeating a false echo storage later with existing buildup.

Inflowing medium

Mounting should not be too close to the inflowing material as the microwave signal will be interferred. The optimum mounting position is on the opposite of the filling. To avoid strong pollution, the distance to the filter or dust extraction must be as big as possible.

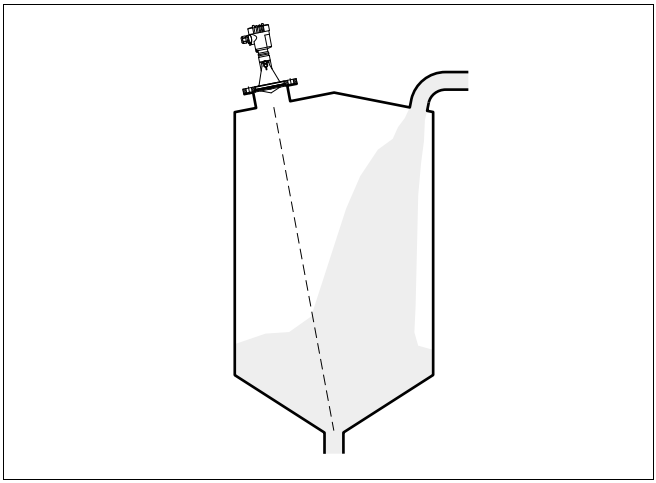


Fig. 7: Mounting of the radar sensor with inflowing medium

Socket

A corresponding collar flange for DN 80 (ASME 3" or JIS 80) as well as a suitable adapter flange are available for mounting MBA PULS 300.

With the housing versions plastic, aluminium single chamber and stainless steel, the collar flange can be placed directly over the housing. With the aluminium double chamber housing, retroactive mounting in this way is not possible - the mounting type must be specified with the order.

Information:
The socket should be as short as possible and the socket end should be rounded. Interfering reflections from the vessel socket are thus minimised.

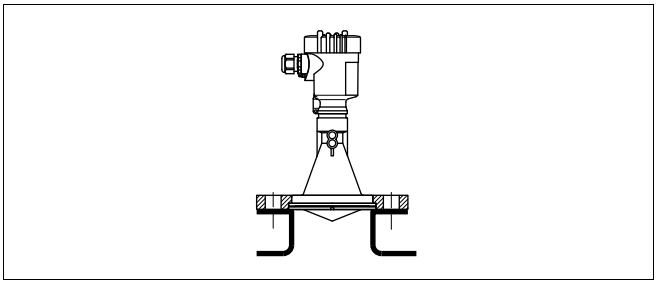
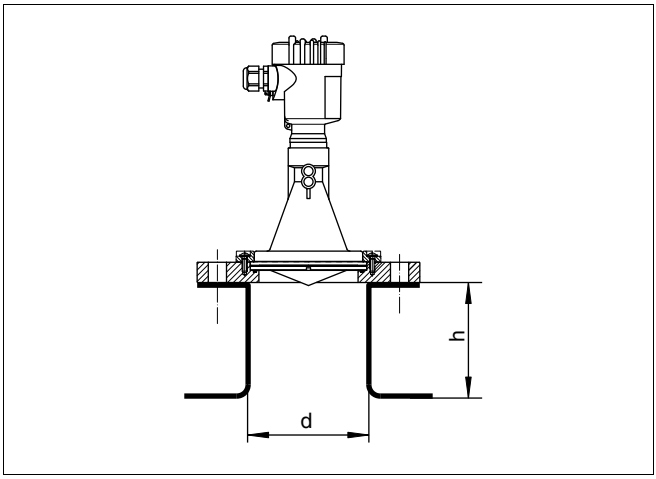


Fig. 8: Recommended socket mounting

If the medium has good reflective properties, MBA PULS 300 can also be mounted on a longer socket piece. Recommended values for socket heights are specified in the following illustration. You must carry out a false echo storage afterwards.



The below charts specify the max. socket piece length h depending on the diameter d.

Socket diameter d	Socket length h
80 mm	300 mm
100 mm	400 mm
150 mm	500 mm

Socket diameter d	Socket length h
3"	11.8 in
4"	15.8 in
6"	19.7 in

Tip:
In new facilities it is useful to incline the vessel socket in the direction of the outlet. False reflections from the vessel wall are thus reduced and measurement all the way down to the bottom of the conical outlet is possible.

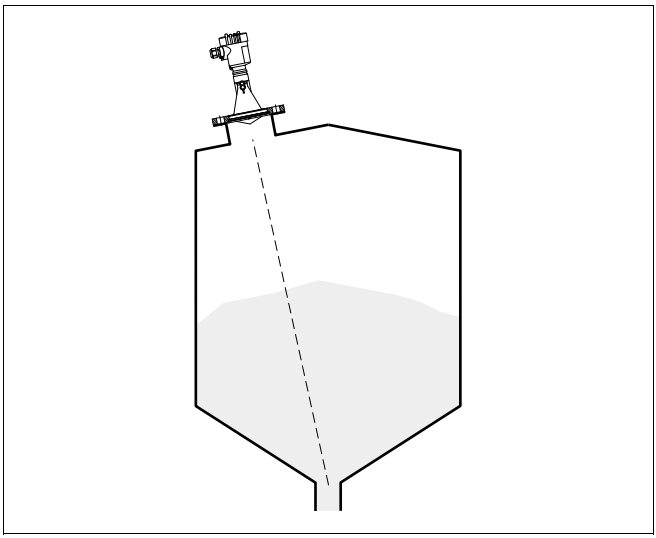


Fig. 10: Alignment in silos

Orientation

To detect nearly the complete vessel volume the sensor should be directed in such a way that the measuring beam reaches the lowest level in the vessel, i.e. the outlet.

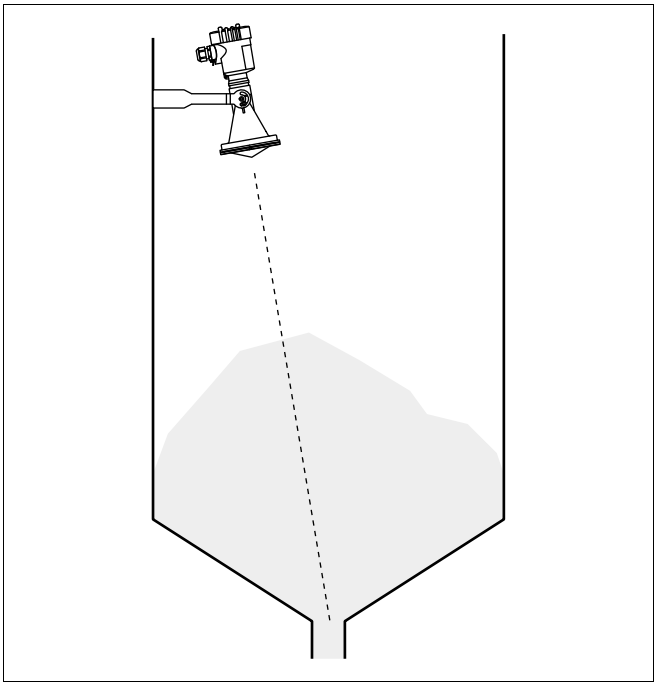


Fig. 11: Mounting in open vessel

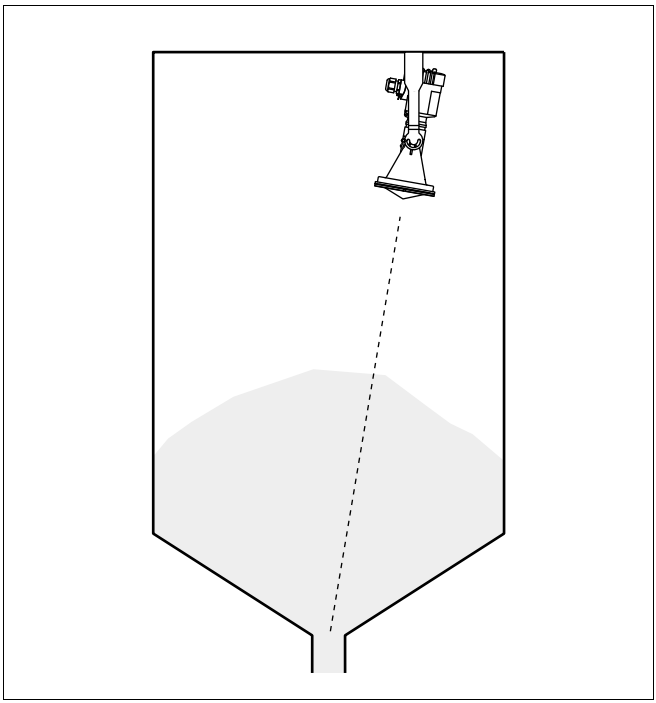


Fig. 12: Mounting on the vessel ceiling

Caution:
When mounting on the vessel ceiling mark sure that the sensor does not overfill. Depending on the measured product, this can cause a mechanical damage.

In a cylindrical silo with conical outlet, it is the easiest way to carry out the mounting on a socket in the center of the silo.

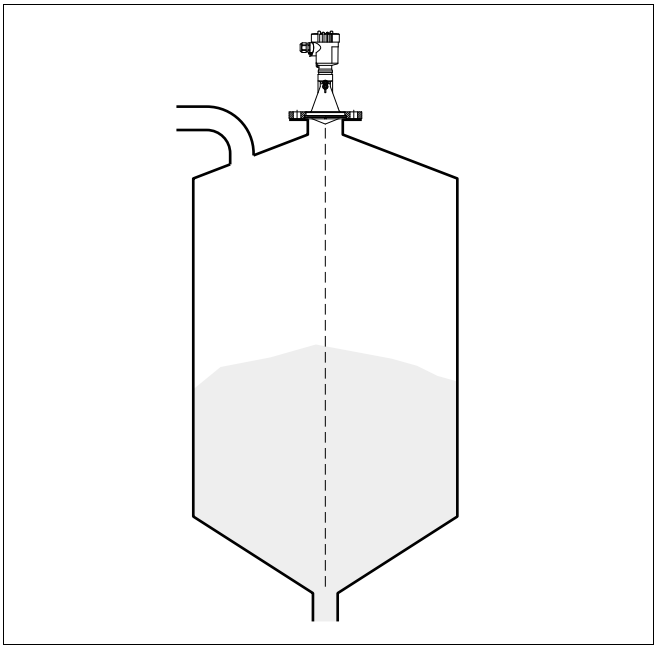


Fig. 13: Orientation

Material heaps

Large material heaps are best measured with several instruments, which can be mounted on e.g. traverse cranes. For this type of application it is advantageous to orient the sensor perpendicular to the bulk solid surface.

The sensors do not influence each other.

Information:
Keep in mind that for these applications, the sensors are designed for relatively slow level changes. If the sensor is used on a movable boom, the max. measuring rate must be observed (see chapter "*Technical data*").

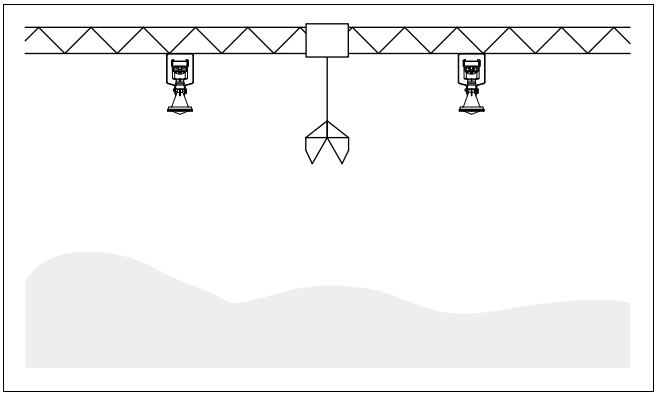


Fig. 14: Radar sensors on traverse crane

Vessel installations

The mounting location of the radar sensor should be a place where no other equipment or fixtures cross the path of the microwave signals.

Vessel installations, such as e.g. ladders, limit switches, heating spirals, struts, etc., can cause false echoes that can influence the useful echo. Make sure when planning your measuring site that the radar sensor has a "clear view" to the measured product.

In case of existing vessel installations, a false echo storage should be carried out during setup.

If large vessel installations such as struts or supports cause false echoes, these can be attenuated through supplementary measures. Small, inclined sheet metal baffles above the installations scatter the radar signals and prevent direct interfering reflections.

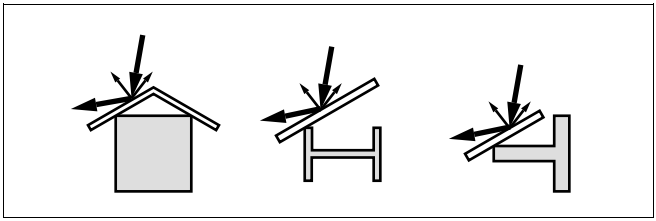


Fig. 15: Cover smooth profiles with deflectors

Agitators

If there are agitators in the vessel, a false signal suppression should be carried out with the agitators in motion. This ensures that the interfering reflections from the agitators are saved with the blades in different positions.

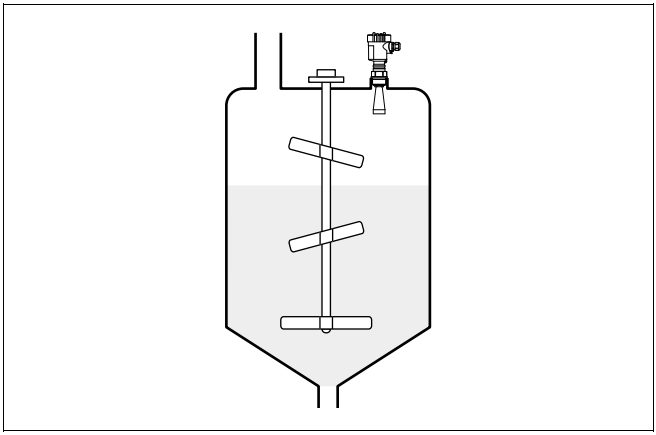


Fig. 16: Agitators

Mounting in multiple chamber silo

The silo walls of multiple chamber silos are often made of profile walls, like e.g. profile sheeting, to ensure the required stability. If the radar sensor is mounted very close to a heavily structured vessel wall, substantial interfering reflections can be generated. Hence the sensor should be mounted at a large distance from the separating wall.

The optimum mounting position is on the outer wall of the silo with the sensor oriented towards the outlet in the silo center.

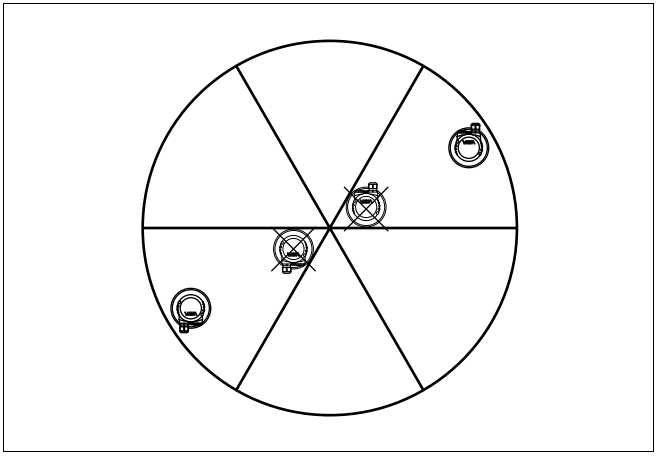


Fig. 17: Installation and orientation in multiple chamber silos

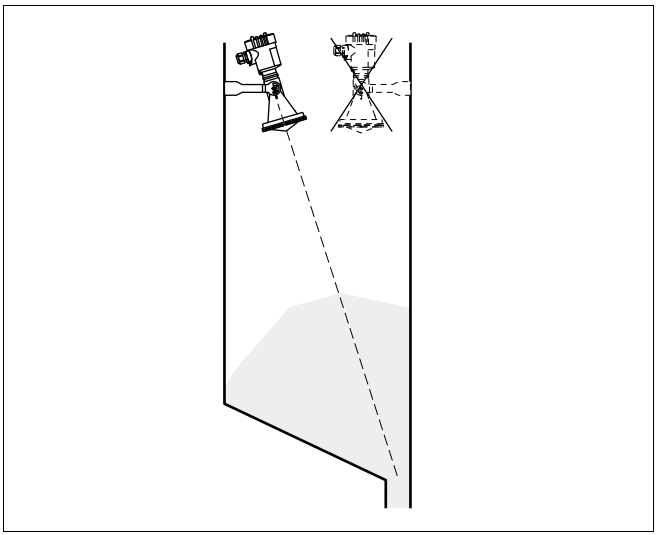


Fig. 18: Installation and orientation in multiple chamber silos

Air rinsing

Air rinsing is useful for avoiding buildup, particularly when there is strong condensation. Since MBA PULS 300 has no direct rinsing air connection, a separate rinsing air connection must be provided in the mounting socket. By inclining this connection towards the top, a particularly effective cleaning of the antenna cover is achieved.

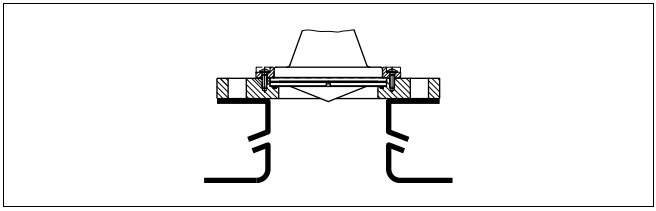


Fig. 19: Purging air connection

5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltages are expected, install overvoltage arresters

Voltage supply

Power supply and current signal are carried on the same two-wire cable. The voltage supply range can differ depending on the instrument version.

The data for power supply are specified in chapter "*Technical data*".

Provide a reliable separation between the supply circuit and the mains circuits according to DIN VDE 0106 part 101.

Keep in mind the following additional influences on the operating voltage:

- Output voltage of the power supply unit can be lower under nominal load (with a sensor current of 20.5 mA or 22 mA in case of fault message)
- Influence of additional instruments in the circuit (see load values in chapter "*Technical data*")

Connection cable

The instrument is connected with standard two-wire cable without screen. If electromagnetic interference is expected which is above the test values of EN 61326 for industrial areas, screened cable should be used.

Use cable with round cross-section. A cable outer diameter of 5 … 9 mm (0.2 … 0.35 in) ensures the seal effect of the cable gland. If you are using cable with a different diameter or cross-section, exchange the seal or use a suitable cable gland.

We generally recommend the use of screened cable for HART multidrop mode.

Cable screening and grounding

If screened cable is necessary, connect the cable screen on both ends to ground potential. In the sensor, the screen must be connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the potential equalisation (low impedance).

If potential equalisation currents are expected, the connection on the processing side must be made via a ceramic capacitor (e. g. 1 nF, 1500 V). The low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

5.2 Connection

Connection technology

The connection of the voltage supply and the signal output is carried out via the spring-loaded terminals in the housing.

The connection to the indicating and adjustment module or to the interface adapter is carried out via contact pins in the housing.

Connection procedure

Proceed as follows:

1 Unscrew the housing cover

2 If an indicating and adjustment module is installed, remove it by turning it slightly to the left.

3 Loosen compression nut of the cable entry

4 Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires

5 Insert the cable through the cable gland into the sensor

Fig. 20: Connection steps 5 and 6

6 Insert the wire ends into the terminals according to the wiring plan

Information:
Solid cores as well as flexible cores with cable end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the terminal head with a small screwdriver; the terminal opening is freed. When the screwdriver is released, the terminal closes again.

7 Check the hold of the wires in the terminals by lightly pulling on them

8 Connect the screen to the internal ground terminal, connect the outer ground terminal with potential equalisation

9 Tighten the compression nut of the cable entry. The seal ring must completely encircle the cable

10 Screw the housing cover on

The electrical connection is finished.

Information:
The terminal block is pluggable and can be removed from the electronics. For this purpose, lift the terminal block with a small screwdriver and pull it out. When inserting the terminal block again, you should hear it snap in.

5.3 Wiring plan, single chamber housing

The following illustration applies to the non-Ex as well as to the Ex-ia version.

Electronics and connection compartment

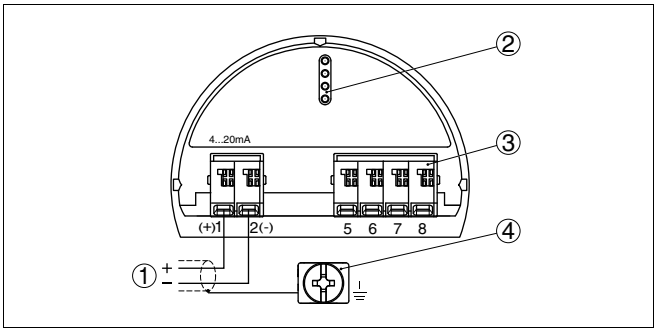


Fig. 21: Electronics and connection compartment with single chamber housing

1 Voltage supply/Signal output
2 For indicating and adjustment module or interface adapter
3 For external indicating and adjustment unit
4 Ground terminal for connection of the cable screen

5.4 Wiring plan, double chamber housing

The following illustrations apply to the non-Ex as well as to the Ex-ia version.

Electronics compartment

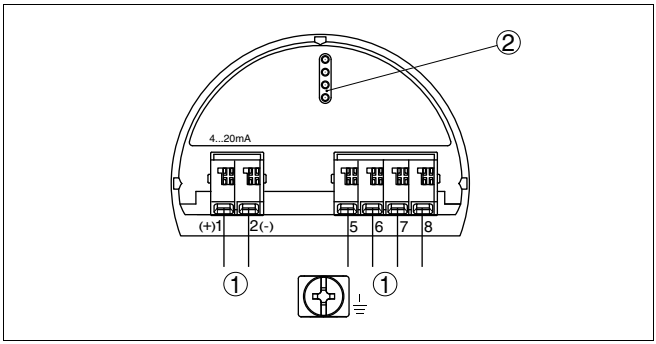


Fig. 22: Electronics compartment, double chamber housing

1 Internal connection to the connection compartment
2 For indicating and adjustment module or interface adapter

Connection compartment

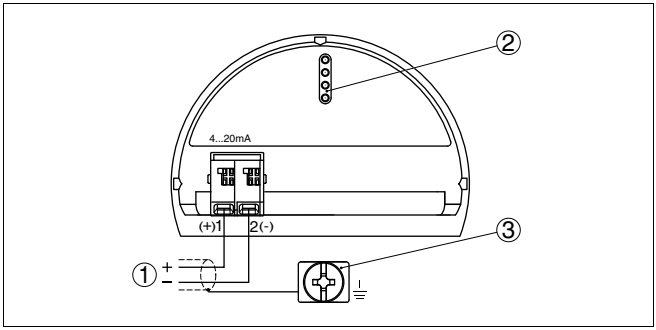


Fig. 23: Connection compartment, double chamber housing

1 Voltage supply/Signal output
2 For indicating and adjustment module or interface adapter
3 Ground terminal for connection of the cable screen

5.5 Wiring plan with double chamber housing Ex d

Electronics compartment

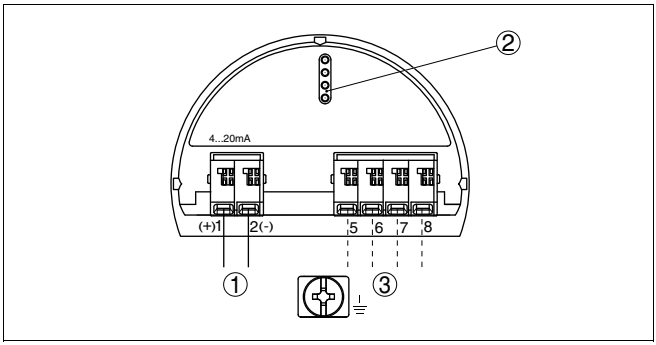


Fig. 24: Electronics compartment, double chamber housing

1 Internal connection to the connection compartment
2 For indicating and adjustment module or interface adapter
3 Internal connection to the plug connector for external indicating and adjustment unit (optional)

Connection compartment

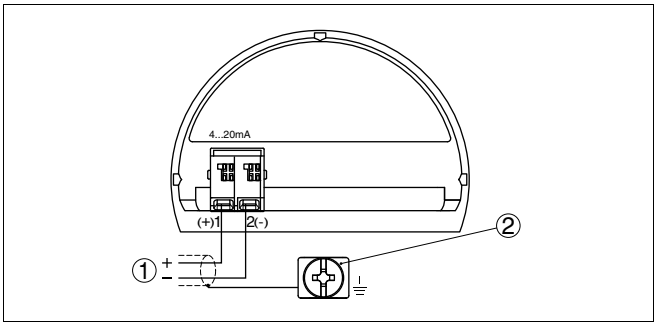


Fig. 25: Connection compartment double chamber housing Ex d

1 Voltage supply/Signal output
2 Ground terminal for connection of the cable screen

5.6 Switch on phase

After connecting the instrument to power supply or after a voltage recurrence, the instrument carries out a self-check for approx. 30 seconds:

- Internal check of the electronics
- Indication of the instrument type, the software version as well as the measurement loop name
- Output signal jumps to the adjusted error current until a plausible measured value is found

Then the corresponding current is outputted to the signal cable. The value corresponds to the actual level as well as the settings already carried out, e.g. factory setting.

6 Set up with the indicating and adjustment module

6.1 Insert indicating and adjustment module

Mount/Dismount indicating and adjustment module

The indicating and adjustment module can be inserted into the sensor and removed again at any time. It is not necessary to interrupt the power supply.

Proceed as follows:

1 Unscrew the housing cover

2 Place the indicating and adjustment module in the desired position on the electronics (you can choose any one of four different positions - each displaced by 90°)

3 Press the indicating and adjustment module onto the electronics and turn it to the right until it snaps in.

4 Screw housing cover with inspection window tightly back on

Removal is carried out in reverse order.

The indicating and adjustment module is powered by the sensor, an additional connection is not necessary.

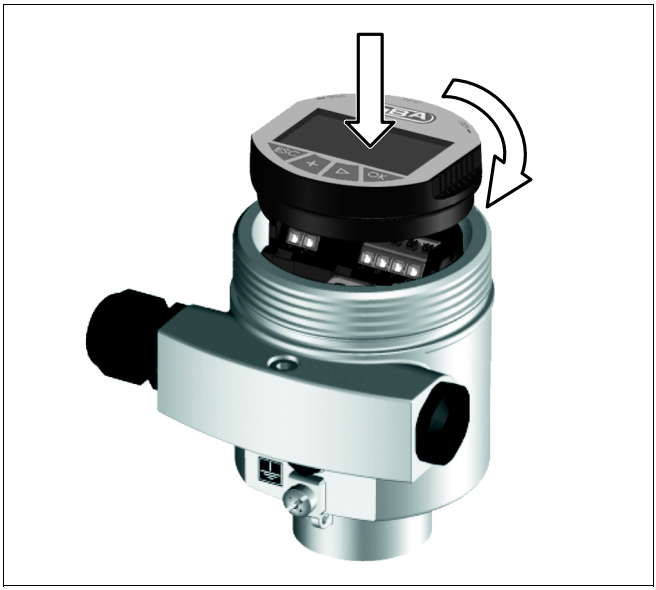


Fig. 26: Insert indicating and adjustment module

Note:
If you intend to retrofit the instrument with an indicating and adjustment module for continuous measured value indication, a higher cover with an inspection glass is required.

6.2 Adjustment system

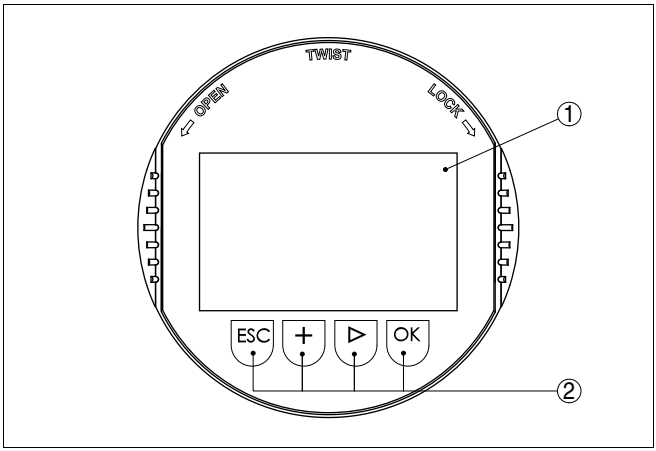


Fig. 27: Indicating and adjustment elements

1 LC display
2 Adjustment keys

Key functions

- ***[OK]*** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value
- ***[->]*** key:
  - Presentation change measured value
  - list entry
  - Select editing position
- ***[+]*** key:
  - Change value of the parameter
- ***[ESC]*** key:
  - interrupt input
  - Jump to next higher menu

Adjustment system

The sensor is adjusted via the four keys of the indicating and adjustment module. The LC display indicates the individual menu items. The functions of the individual keys are shown in the above illustration. Approx. 10 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with ***[OK]*** will not be saved.

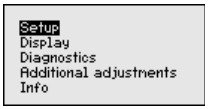
6.3 Parameter adjustment

With the parameter adjustment, the instrument is adapted to the application conditions. The parameter adjustment is carried out via an adjustment menu.

Information:
In this operating instructions manual, the instrument-specific parameters are described. Further general parameters are described in the operating instructions manual "*Indicating and adjustment module*".

Main menu

The main menu is divided into five areas with the following functions:



Setup: Settings, for example, to measurement loop name, medium, application, vessel, adjustment, signal output

Display: Language setting, settings for the measured value indication as well as lighting

Diagnosis: Information, for example to the instrument status, pointer, reliability, simulation, echo curve

Further settings: Unit, false signal suppression, linearisation curve, reset, date/time, reset, HART mode

Info: Instrument name, hardware and software version, calibration date, instrument features

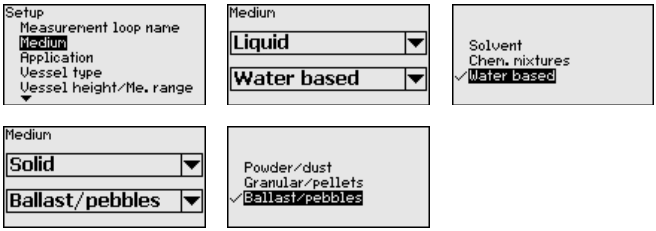
In the main menu point "*Setup*", the individual submenu points should be selected subsequently and provided with the correct parameters to ensure the optimum adjustment of the measurement. The procedure is described in the following.

Setup

Setup/Medium

Each medium has different reflection properties. With liquids, further interfering factors are fluctuation product surface and foam generation. With bulk solids, these are dust generation, material cone and additional echoes from the vessel wall.

To adapt the sensor to these different measuring conditions, the selection "*Liquid*" or "*Bulk solid*" should be made in this menu item.



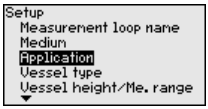
Through this selection, the sensor is adapted perfectly to the product and measurement reliability, particularly in products with poor reflective properties, is considerably increased.

Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

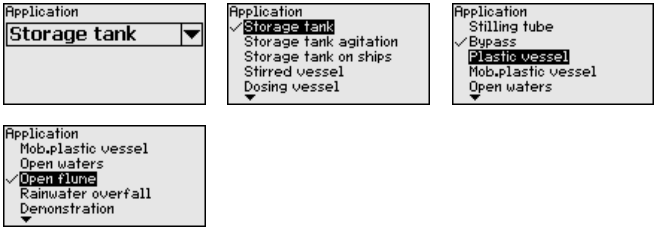
Setup/Application

In addition to the medium, also the application or the application place can influence the measurement.

With this menu item, the sensor can be adapted to the applications. The adjustment possibilities depend on the selection "*Liquid*" or "*Bulk solid*" under "*Medium*".



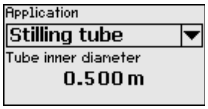
The following options are available when "*Liquid*" was selected:

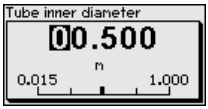


Caution:
If in the vessel, there is a separation of liquids with different ε_r value, for example by condensation, the radar sensor can detect under certain circumstances only the medium with the higher dielectric value. Keep in mind that interfaces can cause faulty measurements.

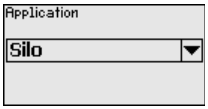
If you want to measure the total height of both liquids reliably, please contact our service department or use an instrument specially designed for interface measurement.

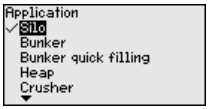
The selection "*Standpipe*" opens a new window in which the inner diameter of the applied standpipe is entered.

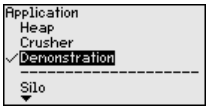




The following options are available when "*Bulk solid*" is selected:







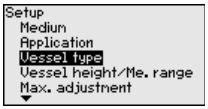
Through this selection, the sensor is adapted optimally to the application or the location and measurement reliability under the various basic conditions is increased considerably.

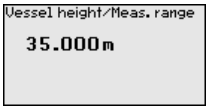
Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

Setup/Vessel height, measuring range

With this selection, the operating range of the sensor is adapted to the vessel height and the reliability with different frame conditions is increased considerably.

Independent from this, the min. adjustment must be carried out.

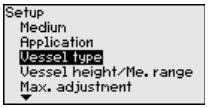


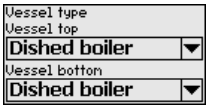


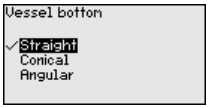
Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

Setup/Vessel form

Also the vessel form can influence the measurement apart from the medium and the application. To adapt the sensor to these measurement conditions, this menu item offers you different options for vessel bottom and ceiling in case of certain applications.







Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

Setup/Adjustment

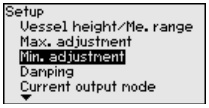
As a radar sensor is a distance measuring instrument, the distance from the sensor to the product surface is measured. To have the real product level displayed, an allocation of the measured distance to the percentage height must be made. To carry out this adjustment, the distance is entered with full and empty vessel. If these values are not known, an adjustment with the distance values, e.g. 10 % and 90 % is also possible. Starting point for these distance specifications is always the seal surface of the thread or flange. By means of these settings, the real level is calculated.

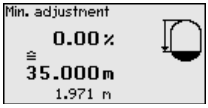
The real product level during this adjustment is not important, because the min./max. adjustment is always carried out without changing the product level. These settings can be made ahead of time without the instrument having to be installed.

Setup/Min. adjustment

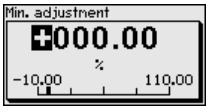
Proceed as follows:

1 Select the menu item "*Setup*" with ***[->]*** and confirm with ***[OK]***. Now select with ***[->]*** the menu item "*Min. adjustment*" and confirm with ***[OK]***.

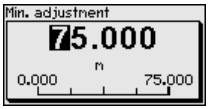




2 Edit the percentage value with ***[OK]*** and set the cursor to the requested position with ***[->]***.



3 Set the requested percentage value with ***[+]*** and save with ***[OK]***. The cursor jumps now to the distance value.



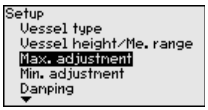
4 Enter the suitable distance value in m for the empty vessel (e.g. distance from the sensor to the vessel bottom) corresponding to the percentage value.

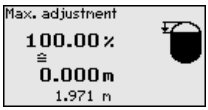
5 Save settings with ***[OK]*** and move with ***[ESC]*** and ***[->]*** to the max. adjustment.

Setup/Max. adjustment

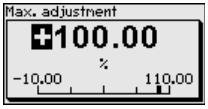
Proceed as follows:

1 Select with ***[->]*** the menu item max. adjustment and confirm with ***[OK]***.

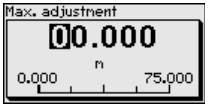




2 Prepare the percentage value for editing with ***[OK]*** and set the cursor to the requested position with ***[->]***.



3 Set the requested percentage value with ***[+]*** and save with ***[OK]***. The cursor jumps now to the distance value.



4 Enter the appropriate distance value in m (corresponding to the percentage value) for the full vessel. Keep in mind that the max. level must lie below the min. distance to the antenna edge.

5 Save settings with ***[OK]***

Further settings

Further settings/False signal suppression

The following circumstances cause interfering reflections and can influence the measurement:

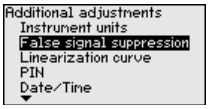
- High sockets
- Vessel installations such as struts
- Agitators
- Buildup or welded joints on vessel walls

Note:
A false signal suppression detects, marks and saves these false signals so that they are no longer taken into account for level measurement.

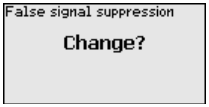
This should be done with a low level so that possible interfering reflections can be detected.

Proceed as follows:

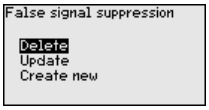
1 Select the menu item "*Additional settins*" with ***[->]*** and confirm with ***[OK]***. With ***[->]*** you have to select the menu item "*False signal suppression*" and confirm with ***[OK]***.



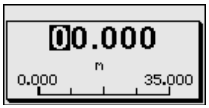
2 Confirm again with ***[OK]***.



3 Confirm again with ***[OK]*** and select with ***[->]*** "*Create new*".



4 Confirm again with ***[OK]*** and enter the actual distance from the sensor to the product surface.

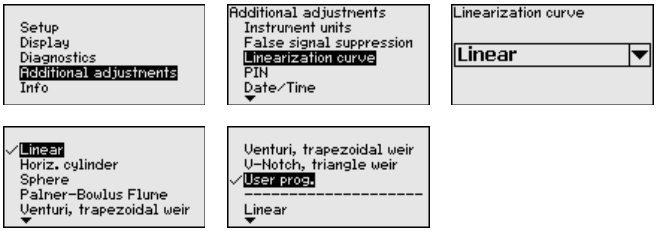


5 All interfering signals in this section are detected by the sensor and stored after confirming with ***[OK]***.

Note:
Check the distance to the product surface, because if an incorrect (too large) value is entered, the existing level will be saved as false signal. The filling level would then no longer be detectable in this area.

Further settings/Linearization curve

A linearization is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. with a cylindrical or spherical tank - and the indication or output of the volume is required. Corresponding linearization curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume. By activating the appropriate curve, the volume percentage of the vessel is displayed correctly. If the volume should not be displayed in percent but e.g. in l or kg, a scaling can be also set in the menu item "*Display*".



Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the ***[ESC]*** and ***[->]*** key.

Caution:
If the instrument is used as part of an overfill protection system according to WHG (Water Resources Act), please note the following:

If a linearisation curve is selected, the measuring signal is no longer compulsorily linear proportional to the level. This must be taken into consideration by the user, particularly when adjusting the switching point on the level switch.

Additional settings - Reset

With a reset, all settings despite a few exceptions will be reset. The exceptions are: PIN, language, lighting, SIL and HART mode.

The following reset functions are available:

Delivery status: Restoring the parameter settings at the time of shipment from the factory. A created false signal suppression, user-programmable linearization curve as well as the measured value memory will be deleted.

Basic settings: Resetting the parameter settings incl. special and laboratory parameters to the default values of the respective instrument. A created false signal suppression, user programmable linearization curve as well as the measured value memory will be deleted.

Setup: Resetting of the parameter settings to the default values of the respective instrument in the menu item Setup. Order-related settings remain but are not taken over into the current parameters. User-generated false signal suppression, user-programmed linearization curve, measured value memory as well as event memory remain untouched. The linearization is set to linear.

False signal suppression: Deleting a previously created false signal suppression. The false signal suppression created in the factory remains active.

Pointer distance: Resetting the measured min. and max. distances to the actual measured value.

The following table shows the default values of the instrument. Depending on the instrument version, not all menu items are available or differently assigned:

Menu	Menu item	Default value
Setup	Medium	Liquid/Water Silo/Bulk solid
	Application	Storage tank
	Vessel height	Max. measuring range, see "*Technical data*" in the supplement
	Vessel form	Vessel bottom, dished boiler end Vessel top, dished boiler end
	Distance min. adjustment	Max. measuring range, see "*Technical data*" in the supplement
	Distance max. adjustment	0,000 m(d)
	Damping	0.0 s
	Current output	Min. current 4 mA, max. current 20 mA
Display	Displayed value	Distance
	Display unit	m
	Scaling	0.00 %, 0 l 100.00 %, 100 l
Further settings	Linearisation curve	linear
	Distance unit	m
	Temperature unit	°C
	Probe length	Length of the standpipe Ex factory

6.4 Saving the parameter adjustment data

It is recommended noting the adjusted data, e.g. in this operating instructions manual and archive them afterwards. They are hence available for multiple use or service purposes.

If the instrument is equipped with an indicating and adjustment module, the data in the sensor can be saved in the indicating and adjustment module. The procedure is described in the operating

instructions manual "*Indicating and adjustment module*" in the menu item "*Copy sensor data*". The data remain there permanently even if the sensor power supply fails.

The following data or settings for adjustment of the indicating and adjustment module are saved:

- All data of the menu "*Setup*" and "*Display*"
- In the menu "*Additional settings*" the items "*Distance unit, temperature unit and linearization*"
- The values of the user programmable linearization curve

The function can be also used to transfer settings from one instrument to another instrument of the same type. If it is necessary to exchange a sensor, then the indicating and adjustment module is inserted into the replacement instrument and the data are also written into the sensor via the menu item "*Copy sensor data*".

7 Diagnosis, fault rectification and service

7.1 Maintenance

When the device is used correctly, no maintenance is required in normal operation.

7.2 Error messages according to NE 107

The instrument has a self-monitoring and diagnosis according to NE 107 and VDI/VDE 2650. The following status messages can be outputted:

Failure: Due to a malfunction in the instrument, a failure message is outpuuted. This status message is activated in the delivery status and cannot be deactivated by the user.

Function check: The instrument is in operation, the measured value is temporarily invalid (for example during simulation). This status message is activatedin the delivery status and cannot be deactivated by the user.

Error codes and text messages are dispayed via the indicating and adjustment module during operation. Information to the error statstics is displayed in the menu diagnosis under *Device status*" in the indicating and adjustment module.

Failure (failure)

The following table shows the codes and text messages of the status message "*Failure*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Removal
F013 no measured value available	● Sensor does not detect an echo during operation ● Antenna system contaminated or defective	● Check or correct installation and/or parameter adjustment ● Clean or exchange process component or antenna
F017 Adjustment span too small	● Adjustment not within specification	● Change adjustment according to the limit values (difference between min. and max. ≥ 10 mm)
F025 Error in the linearization table	● Index markers are not continuously rising, for examle unlogical value pairs	● Check linearization table ● Delete table/Create new

Code Text message	Cause	Removal
F036 No operable software	● Failed or interrupted software update	● Repeat software update ● Check electronics version ● Exchange the electronics ● Send instrument for repair
F040 Error in the electronics	● Hardware defect	● Exchange the electronics ● Send instrument for repair
F080	● General software error	● Separate operating voltage briefly
F105 Determine measured value	● The instrument is still in the start phase, the measured value could not yet be determined	● Wait for the warm-up phase ● Duration depending on the version and parameter adjustment up to approximately 3 min.
F125 Unpermissible electronics temperature	● Temperature of the electronics in the not specified section	● Check ambient temperature ● Isolate electronics ● Use instrument with higher temperature range
F260 Error in the calibration	● Error in the calibration carried out in the factory ● Error in the EEPROM	● Exchange the electronics ● Send instrument for repair
F261 Error in the configuration	● Error during setup ● False signal suppression faulty ● Error when carrying out a reset	● Repeat setup ● Repeat reset
F264 Installation/Setup error	● Adjustment not within the vessel height/measuring range ● Max. measuring range of the instrument not sufficient	● Check or correct installation and/or parameter adjustment ● Use an instrument with bigger measuring range
F265 Measurement function disturbed	● Sensor does no longer carry out a measurement ● Operating voltage too low	● Check operating voltage ● Carry out a reset ● Separate operating voltage briefly

Function check

The following table shows the codes and text messages of the status message "*Function check*" and provides information on causes as well as corrective measures.

Text message	Cause	Removal
C700 Simulation	● Simulation active	● Finish simulation ● Wait for the automatic end after 60 mins.

7.3 Rectify malfunctions

Reaction when malfunctions occur

The operator of the system is responsible for taking suitable measures to rectify malfunctions.

Fault rectification

The first measures to be taken are to check the output signal as well as to evaluate the error messages via the indicating and adjustment module. Further comprehensive diagnostics can be carried out on a PC with the software PACTware and the suitable DTM. In many cases, the causes can be determined this way and faults rectified.

Reaction after fault rectification

Depending on the failure reason and measures taken, the steps described in chapter "*Set up*" must be carried out again, if necessary.

7.4 How to proceed in case of repair

If it is necessary to repair the instrument, please contact the responsible MBA agency.

8 Dismounting

8.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

8.2 Dispose

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

Correct disposal avoids negative effects to persons and environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you have no possibility to dispose of the old instrument professionally, please contact us concerning return and disposal.

9 Supplement

9.1 Technical data

General data

316L corresponds to 1.4404 or 1.4435	
Materials, wetted parts	
– Adapter flange	PPH
– Seal, adapter flange	PPH
– Antenna	PBT-GF 30
– Focussing lens	FKM (Viton)
Materials, non-wetted parts	
– Compression flange	PPH
– Mounting strap	316L
– Fixing screws, mounting strap	316L
– Fixing screws, adapter flange	304
– Plastic housing	plastic PBT (Polyester)
– Aluminium die-casting housing	Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
– Stainless steel housing - precision casting	316L
– Stainless steel housing, electropolished	316L
– Seal between housing and housing cover	NBR (stainless steel housing, investment casting), silicone (Aluminium/plastic housing, stainless steel housing, electro-polished)
– Inspection window in housing cover (optional)	Polycarbonate
– Ground terminal	316L
Process fittings	
– Flanges	DIN from DN 80, ANSI from 3", JIS from DN 100 10K
Weight depending on process fitting and housing material	0.7 … 3.4 kg (1.543 … 7.496 lbs)
Max. torque, mounting screws - strap on the sensor housing	4 Nm
Max. torque for NPT cable glands and Conduit tubes	
– Plastic housing	10 Nm (7.376 lbf ft)
– Aluminium/Stainless steel housing	50 Nm (36.88 lbf ft)

Input variable

Measured variable	Distance between process fitting sensor and product surface. The reference plane is the seal surface of the flange.

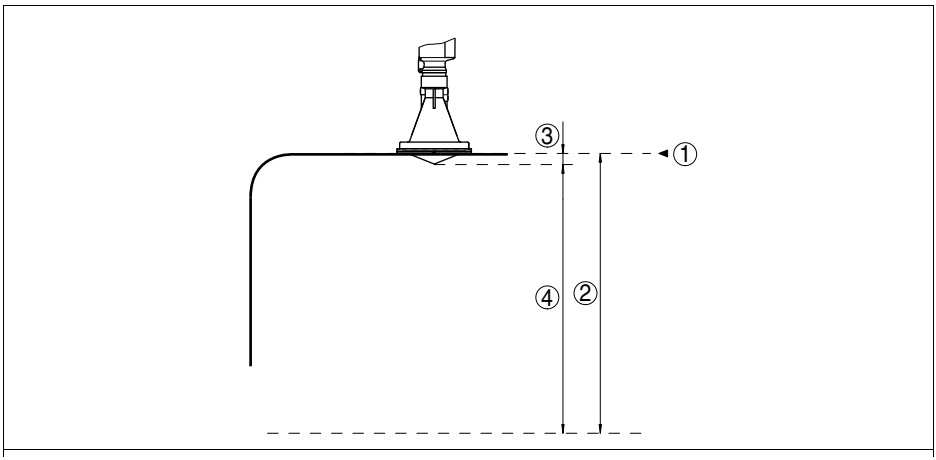


Fig. 28: Data of the input variable

1 Reference plane
2 Measured variable, max. measuring range
3 Antenna length
4 Useful measuring range

Max. measuring range	up to 15 m (49.21 ft)
Recommended measuring range	up to 15 m (49.21 ft)
Min. distance from antenna end	50 mm (1.969 in)[1)]

Output variable

Output signal	4 … 20 mA/HART
Cycle time measuring cycle approx.	
– Standard electronics	0.5 s
– Electronics with increased sensitivity	1 s
Signal resolution	0.3 µA
Residual ripple	±0.4 µA
Failure signal current output (adjustable)	mA-value unchanged 20.5 mA, 22 mA, < 3.6 mA
Max. output current	22 mA
Starting current	≤ 3.6 mA; ≤ 10 mA for 5 ms after switching on
Load	see load diagram under Power supply
Damping (63 % of the input variable)	0 … 999 s, adjustable
HART output values according to HART 7.0[2)]	
– PV (Primary Value)	Distance to the level
– SV (Secondary Value)	Level as percentage value

1) In products with low dielectric value up to 50 cm (19.69 in).
2) Default values, can be assigned individually

– TV (Third Value)	Linearised percentage value
– QV (Fourth Value)	Scaled measured value
Resolution, digital	< 1 mm (0.039 in)

Accuracy (similar to DIN EN 60770-1)

Process reference conditions according to DIN EN 61298-1

– Temperature	+18 … +30 °C (+64 … +86 °F)
– Relative humidity	45 … 75 %
– Air pressure	860 … 1060 mbar/86 … 106 kPa (12.5 … 15.4 psig)

Installation reference conditions

– Min. distance to installations	> 200 mm (7.874 in)
– Reflector	Corner reflector
– False reflections	Biggest false echo, 20 dB smaller than the useful echo
Deviation with liquids	See following diagrams

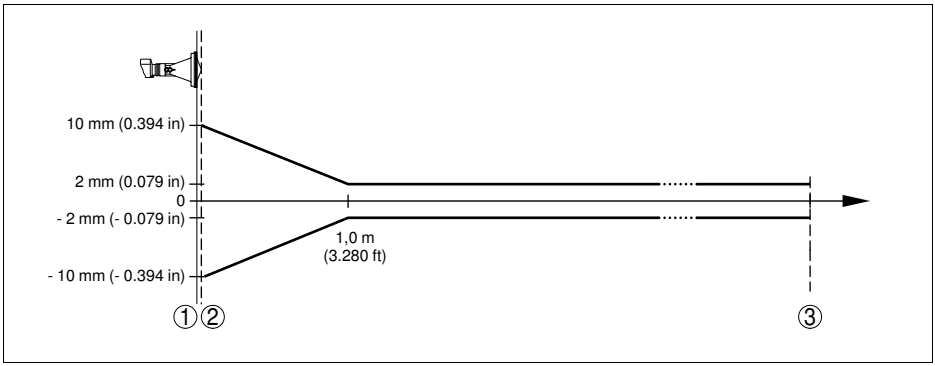


Fig. 29: Deviation under reference conditions

1 Reference plane
2 Antenna edge
3 Recommended measuring range

Deviation with bulk solids	The values are considerably application-dependent. Firm specifications are hence not possible.
Reproducibility	≤ ±1 mm

Characteristics and performance data

Frequency	K-band (26 GHz technology)
Beam angle -3 dB[3)]	10°

[3)] Corresponds to the range with 50 % of the emitted power

Step response time[4]	> 1 s (dependent on the parameter setting)
Max. level change	1 m/min.
Max. emitted HF power of the antenna system	
– Pulse peak power	< 10 mW
– Pulse duration	< 2 ns
– Average power	< 25 µW
– Average power with 1 m distance	< 1 µW/cm²

Influence of the ambient temperature to the sensor electronics

Temperature drift	±0.03 %/10 K relating to the 16 mA span max. ±0.3 %
Temperature drift - Digital output	±3 mm/10 K relating to the max. measuring range or max. 10 mm

Ambient conditions

Ambient, storage and transport temperature	-40 … +80 °C (-40 … +176 °F)

Application conditions (process conditions)

Process temperature (measured on the process fitting)	-40 … +80 °C (-40 … +176 °F)
Vessel pressure	-1 … 2 bar (-100 … 200 kPa/-14.5 … 29.0 psig)
Vibration resistance	mechanical vibrations with 4 g and 5 … 100 Hz[5]

Electromechanical data - version IP 66/IP 67 and IP 66/IP 68; 0.2 bar

Cable entry/plug[6]

– Single chamber housing

- 1 x cable gland M20 x 1.5 (cable: ø 5 … 9 mm), 1 x blind stopper M20 x 1.5

or:

- 1 x closing cap M20 x 1.5; 1 x blind stopper M20 x 1.5

or:

- 1 x closing cap ½ NPT, 1 x blind plug ½ NPT

or:

- 1 x plug (depending on the version), 1 x blind stopper M20 x 1.5

[4] Time span after a sudden level change until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).

[5] Tested according to the regulations of German Lloyd, GL directive 2.

[6] Depending on the version M12 x 1, according to DIN 43650, Harting, 7/8" FF.

– Double chamber housing	• 1 x cable entry M20 x 1.5 (cable: ø 5 … 9 mm), 1 x blind stopper M20 x 1.5; 1 x blind stopper M16 x 1.5 or optional[7]1 x plug M12 x 1 for external indicating and adjustment unit or: • 1 x closing cap ½ NPT, 1 x blind stopper ½ NPT, 1 x blind stopper M16 x 1.5 or optionally[8]1 x plug M12 x 1 for external indicating and adjustment unit or: • 1 x plug (depending on the version), 1 x blind stopper M20 x 1.5; 1 x blind stopper M16 x 1.5 or optionally[9]1 x plug M12 x 1 for external indicating and adjustment unit
Spring-loaded terminals for wire cross-section	
– Massive wire, cord	0.2 … 2.5 mm² (AWG 24 … 14)
– Cord with cable end sleeve	0.2 … 1.5 mm² (AWG 24 … 16)

Indicating and adjustment module

Voltage supply and data transmission	through the sensor
Indication	LC display in dot matrix
Adjustment elements	4 keys
Protection rating	
– unassembled	IP 20
– mounted into the sensor without cover	IP 40
Materials	
– Housing	ABS
– Inspection window	Polyester foil

Integrated clock

Date format	Day.Month.Year
Time format	12 h/24 h
Time zone Ex factory	CET

Electronics temperature measurement

Resolution	1 °C (1.8 °F)
Accuracy	±1 °C (1.8 °F)

Voltage supply

Operating voltage

[7] Only with Ex d version
[8] Only with Ex d version
[9] Only with Ex d version

– Non-Ex instrument	9.6 … 36 V DC
– Ex-ia instrument	9.6 … 30 V DC
– Ex-d-ia instrument	14 … 36 V DC

Operating voltage with lighted indicating and adjustment module

– Non-Ex instrument	16 … 36 V DC
– Ex-ia instrument	16 … 30 V DC
– Ex-d-ia instrument	20 … 36 V DC

Interpolation protection	Available

Permissible residual ripple - Non-Ex, Ex-ia instrument

– for 9.6 $V_{< U_N}$ < 14 V	≤ 0.7 V_{eff} (16 … 400 Hz)
– for 18 $V_{< U_N}$ < 36 V	≤ 1.0 V_{eff} (16 … 400 Hz)

Permissible residual ripple - Ex-d-ia instrument

– for 18 $V_{< U_N}$ < 36 V	≤ 1 V_{eff} (16 … 400 Hz)
Load	see diagram

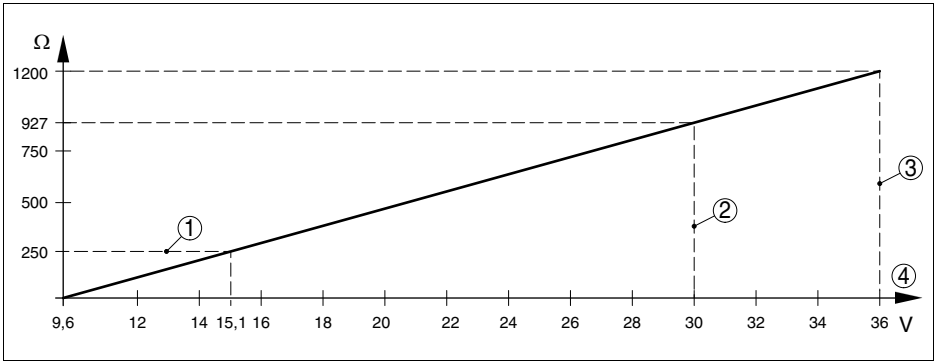


Fig. 30: Voltage diagram

1 HART load
2 Voltage limit Ex-ia instrument
3 Voltage limit non-Ex/Exd instrument
4 Operating voltage

Electrical protective measures

Protection, depending on housing version

– Plastic housing	IP 66/IP 67
– Aluminium housing, stainless steel housing - investment casting, stainless steel housing - electro-polished	IP 66/IP 68 (0.2 bar)[10)]
– Aluminium and stainless housing, investment casting (optionally available)	IP 66/IP 68 (1 bar)

[10)] The prerequisites for maintaining the protection rating are a suitable cable as well as correct mounting.

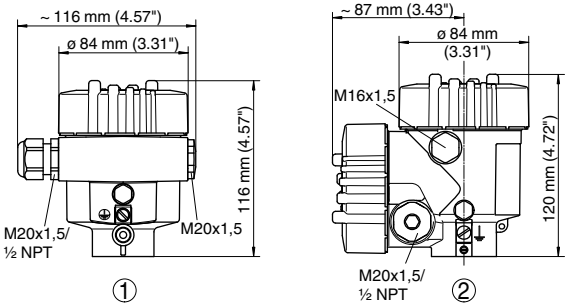
Overvoltage category	III
Protection class	II

Approvals

Instruments with approvals can have deviating technical data (depending on the version). For such instruments, the corresponding approval documents must be noted.

9.2 Dimensions

Aluminium housing



1 Single chamber version
2 Double chamber version

MBA PULS 300 - version with mounting strap

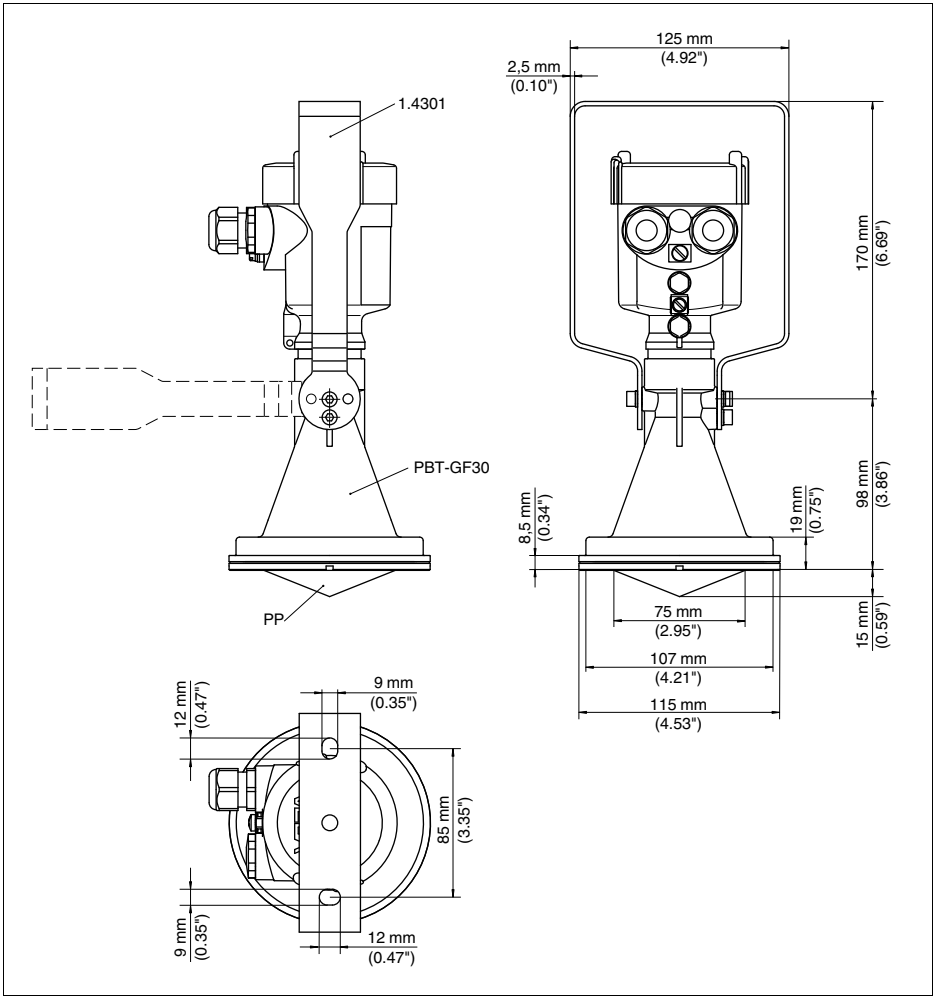


Fig. 32: MBA PULS 300 - version with mounting bracket 170 or 300 mm in length

MBA PULS 300 - version with compression flange

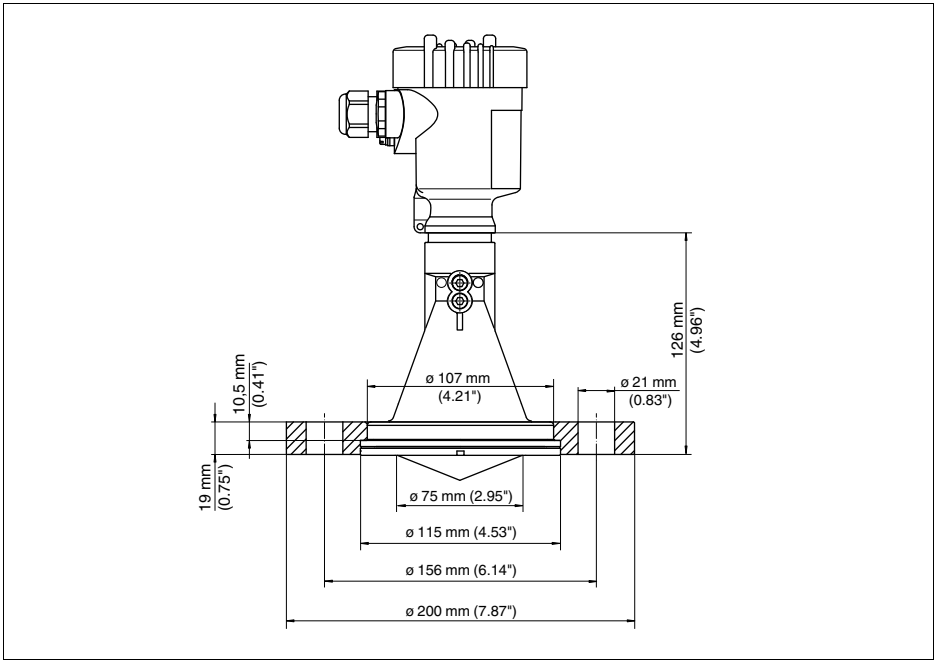
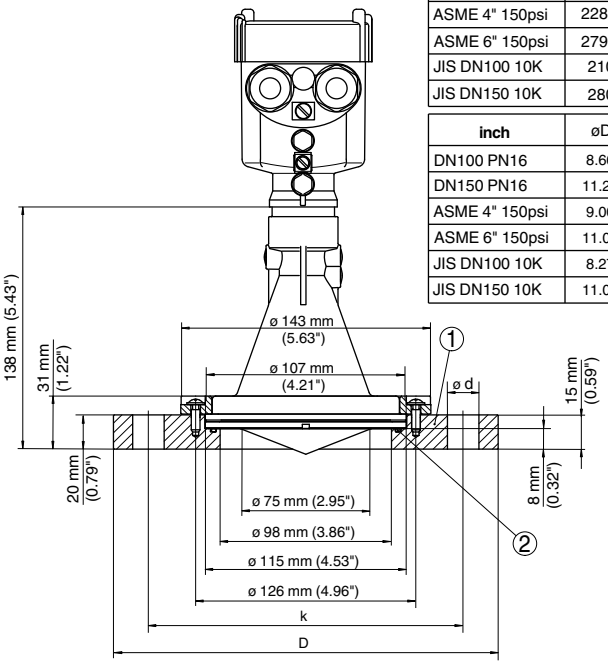


Fig. 33: MBA PULS 300 - compression flange DN 80/3"/JIS80

MBA PULS 300 - version with adapter flange



mm	øD	øk	ød	
DN100 PN16	220	180	18	8x45°(=360°)
DN150 PN16	285	240	22	8x45°(=360°)
ASME 4" 150psi	228,6	190,5	19,1	8x45°(=360°)
ASME 6" 150psi	279,4	241,3	22,4	8x45°(=360°)
JIS DN100 10K	210	175	19	8x45°(=360°)
JIS DN150 10K	280	240	23	8x45°(=360°)

inch	øD	øk	ød	
DN100 PN16	8.66"	7.09"	0.71"	8x45°(=360°)
DN150 PN16	11.22"	9.45"	0.87"	8x45°(=360°)
ASME 4" 150psi	9.00"	7.50"	0.75"	8x45°(=360°)
ASME 6" 150psi	11.00"	9.50"	0.88"	8x45°(=360°)
JIS DN100 10K	8.27"	6.89"	0.75"	8x45°(=360°)
JIS DN150 10K	11.02"	9.45"	0.91"	8x45°(=360°)

Fig. 34: MBA PULS 300 - adapter flange DN 100/DN 150

1 Adapter flange
2 Seal

INDEX

A
Adjustment 34
– Max. adjustment 35
– Min. adjustment 34
Adjustment system 30
Agitator 20
Application
– Bulk solid 33
– Liquid 32
– Standpipe 33

C
Cable screening 23
Connection cable 23

D
Default values 38

E
Electronics and connection compartment with single chamber housing 25
Electronics compartment, double chamber housing 26-27
Equipment
– Indicating and adjustment module 8

F
Fault rectification 42
Functional principle 8

G
Gating out of false signals 35
Grounding 23

K
Key function 30

L
Linearisation curve 36

M
Main menu 31
Medium
– Bulk solid 31
Moisture 9

N
NAMUR NE 107
– Failure 40
– Function check 41

O
Overfill protection according to WHG 37

P
Potential equalisation 23

R
Reflection properties 32
Reset 37

S
Shielding 23
Status messages 40

T
Type label 7

V
Vessel form 33
Vessel height 33
Vessel installations 20
Voltage supply 23

36824-EN-100208

Druckdatum:

MBA Instruments GmbH
Friedrich-List-Str. 5
25451 Quickborn
Germany
Phone +49 4106 123 888 - 1
Fax +49 4106 123 888 - 9
Email: info@mba-instruments.de
www.mba-instruments.de

CE

Die Angaben über Lieferumfang, Anwendung, Einsatz und Betriebsbedingungen der Sensoren und Auswertsysteme entsprechen den zum Zeitpunkt der Drucklegung vorhandenen Kenntnissen.

36824-EN-100208